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Laser Safety Inspection Criteria

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A responsibility of the Laser Safety Officer (LSO) is to perform laser audits. The American National Standard Z136.1 Safe Use of Lasers references this requirement through several sections. One such reference is Section 1.3.2.8, Safety Features Audits, "The LSO shall ensure that the safety features of the laser installation facilities and laser equipment are audited periodically to assure proper operation". The composition, frequency and rigor of that inspection /audit rests in the hands of the LSO. A common practice for institutions is to develop laser audit checklists or survey forms

It is common for audit findings from one inspector or inspection to the next to vary even when reviewing the same material. How often has one heard a comment, "well this area has been inspected several times over the years and no one ever said this or that was a problem before!" A great number of audit items, and therefore findings, are subjective because they are based on the experience and interest of the auditor to particular items on the checklist. Beam block usage, to one set of eyes might be completely adequate, while to another, inadequate. In order to provide consistency, the Laser Safety Office of the National Ignition Facility Directorate has established criteria for a number of items found on the typical laser safety audit form.

The criteria are distributed to laser users. It serves two broad purposes; first, it gives the user an expectation of what will be reviewed by an auditor. Second, it is an opportunity to explain audit items to the laser user and thus the reasons for some of these items, such as labelling of beam blocks.

The following are some examples from the audit criteria handout:

Safety Documentation

Interlock Log: Checks need to be current; that is, one check per quarter (no more than 90 days between checks is the goal). These checks are generally an operational performance. For complex systems a written procedure is required for the tester to follow and note problems. The preference is for all labs to follow a written procedure. This assures consistency between checks regardless of who in the lab performs the check. If problems are noted, follow up action and documentation of resolution is required.

Alignment Procedure: At a minimum, there should be general laser alignment guidance[1]. Whenever possible, laser use specific alignment procedures should be developed for the different laser activities. System start up procedures could be considered part of this.

Posting & Labelling

Hazard Communication poster: Laser hazards need to be on the Hazard Communication poster. Check the poster to see that it represents all hazards in the room, not just your work.

Laser sign: Laser use areas (Class 3B or Class 4 lasers) are required to be posted with a laser warning sign. The sign should accurately convey the wavelengths in use and any laser protective eyewear requirements. The sign needs to be on all accessible entrances to the laser use area.

Emergency Contact: Many lab doors have emergency contact information posted. It must be readable and accurate.

Beam Enclosures

The goal is to contain the laser beam and any stray radiation to the optical table or intended use area. Enclosures that confine the beam are one of the best methods to accomplish this. This means individual portions of the laser beam can be contained as in a beam tube, or containment can be of the optical set up, by means of a barrier around the entire table or portions of it. This barrier can be several inches higher than the intended beam path, open or closed at the top, or panels several feet high enclosing the entire table.

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[1] Contact the NIF LSO for a copy.

Total enclosure This is the preferred but not always possible method. Panels can be labeled with an interlocked or non-interlocked warning label(s).

Totally open While not preferred, in some cases it maybe the only workable option. In such a case, use of properly placed beam blocks is critical to safety. A check for stray reflections is required after each alignment or beam manipulation.

Combination In some cases beams will not be totally open or totally enclosed but at times a combination of both. A combination approach is acceptable.

Perimeter guard It must be of sufficient height above the intended beam height to prevent a likely stray reflection from rising above the guard. Upward angled beams are a concern.

Beam tubes For open distances between optics over 2 feet it is recommended that beam tubes be employed. The tube need not be of a material opaque to the laser radiation, although that is preferred. Keeping hands out of the beam is the major goal.

Protective eyewear

Laser protective eyewear is a critical part of laser safety for the individual. Chiefly, it relies on the user to wear the proper eyewear and take care not to abuse the eyewear. All laser users need to know is that they have an obligation to make sure all in the laser lab are wearing the proper eyewear when a laser radiation hazard is present.

Full Protection: This type is designed so that the optical density of the eyewear will absorb all the laser radiation from a direct hit for a period of up to 10 seconds. Intra beam or direct viewing of the laser beam is strictly forbidden.

Alignment: Use of alignment eyewear is allowed for visualization of visible beams for alignment activities. The NIF LSO grants approval of such eyewear.

Labelled: The required labelling is the optical density (OD) and wavelengths for which the eyewear designed. Labelling on some common styles of eyewear can wear off. Unlabelled eyewear, or eyewear with unreadable labelling must be removed. Labelling can be self adhered.

Quantity: The quantity of eyewear on hand must be sufficient for the expected number of daily users and anticipated visitors. Visitors should be limited to full protection eyewear only.

Condition: Laser eyewear must be in good condition, free from scratches, abrasions or burns in critical vision areas.

Correct OD: The OD on eyewear must meet the levels required for the laser applications in the SOP.

Prescription Age: Due to the cost of the prescription laser eyewear, the user may be using a pair with a prescription several years old. A consultation with Health Services is required to determine if a new set of eyewear is required.

Storage: Eyewear must be stored in a manner that preserves its condition. Storage can be outside the laser use area or inside. Each approach has advantages and disadvantages.

Holder: The storage of laser protective eyewear will have a direct effect on its lifetime. The practice of eyewear being thrown in a draw or left on tables (at the end of the day) is considered unacceptable. The NIF LSO provides a wall pouch holder on request.

Beam Containment

Beam Blocks: These should be made of a material that will be non-combustible for the power output expected to strike the block. It must not transmit the wavelength in use. Cardboard may be suitable for some applications while metal will be required for others. The block should not be reflective for the wavelengths being used. All active beam blocks must be secured to the optical table (foot print stops that tip over must be approved by NIF LSO). The size of the blocks must be sufficient to block the beam diameter and potentially misaligned beams. A label on the block indicating that it is a beam block and that it is not to be moved is recommended but not required. Such labeling is considered a good practice to help locate any beam blocks that might be misplaced or knocked over.

Housekeeping

On laser work surfaces: The area on the optical table encompassing and directly adjacent to the beam path needs to be free of all non-essential reflective sources. This includes optics, tools, foil, and storage containers. This does not include established alternate beam paths for related experiments.

Related work surfaces: Adequate Storage space: Space is always a premium in any laboratory; the more organized the space is the safer the work area will be. Programs should make resources available to

individual labs to aid in this goal. Users have a dual responsibility here, first to remove unused equipment, either to surplus or storage outside the lab, and most importantly, to keep an on going effort to organize and put away supplies.

Trip hazards: To protect cords and hoses from tears and prevent tripping over them a number of commercial devices are available. The application of these devices needs to be reviewed during the audit.

Emergency lighting: The reviewer should see that quantity and locations are adequate, and that it is tested for functionality.

SUMMARY

The goal of the criteria list is to aid the laser user in understanding laser safety. It gives the user an expectation of what will be reviewed. It is an opportunity to explain audit items and their rationale. It can also serves as the basis for user self assessment reviews of their laser use area. Hopefully, this leads to greater laser safety and less confrontational audits.

The goal of the explanation of these common items is that laser users will develop and use safer laser work practices. A complete laser audits criteria can be obtain by emailing Ken Barat at barat1@llnl.gov.

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